LALP-03-101

Accelerator Development Activities in 2002

C. Pillai, R.C. McCrady, M.S. Gulley (LANSCE Division)

There is a continuous effort to better understand the performance of the linear accelerator (linac) at the Los Alamos Neutron Science Center (LANSCE) to improve its performance and deliver optimum beams to the experimental areas. The following development activity was undertaken during the 2002 run cycle, specifically to understand the properties of the Weapons Neutron Research Facility (WNR) beam in the low-energy beam transport (LEBT). The normal production current to WNR Target 4 is about 4.5 mA compared to the possible 10 mA that the target can handle. Measuring the beam parameters for the WNR beam in the linac during the 2001 run cycle revealed that the transverse beam size in the linac was consistently larger than that of the Proton Storage Ring (PSR) beam by about 25%. In addition, low-capture efficiency and higher beam losses may have occurred because the measured beam emittance at the end of the linac was about 50% larger for the WNR beam than that for the PSR beam.

Measuring Beam Emittance

We measured the beam emittance for both PSR (long-bunch enable gate) (Fig. 1) and WNR (micropulse enable gate) (Fig. 2) beams at the entrance to the 201.25-MHz drift-tube linac. The horizontal emittance for the WNR beam was about 50% larger than that of the PSR beam, and the vertical emittance for the WNR beam was about 70% larger than that of the PSR beam. (Remember that the beam is chopped in the vertical direction for both

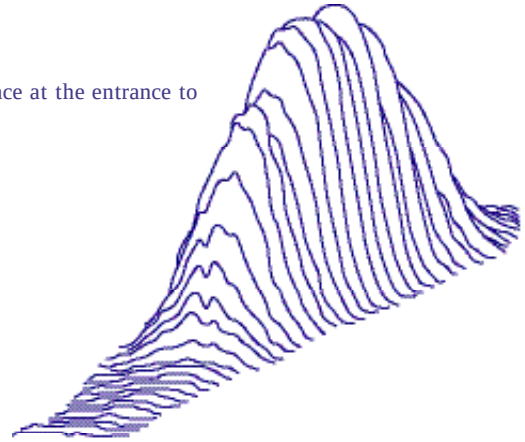
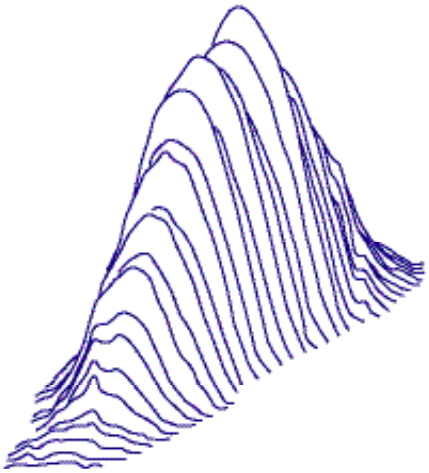


Fig. 1. PSR beam emittance at the entrance to the LANSCE linac.

Run: 14229/STN: TDEM1-H/12-17-02/21:03:21

Beam H-	Measurement	Norm
Emittance (total)	4.140	0.166 pi
Emittance (edge)	3.949 pi	
Emittance (rms)	0.460	0.018 pi
Emittance (total/rms)	9.01	
Alpha	-1.963	
Beta	0.171	
4 x emittance (rms)	1.839 pi	
C	0.110 cm	
CP	0.043 mr	
X Sigma	0.2808 cm	
XP Sigma	3.6076 mr	
Threshold	2.0%	
Threshold	21 CNTS	
Maximum counts	1081	
Beam through threshold	250668	
Total beam	275142	
Charge-collector position	1940	1930
Jaw position	1939	1931



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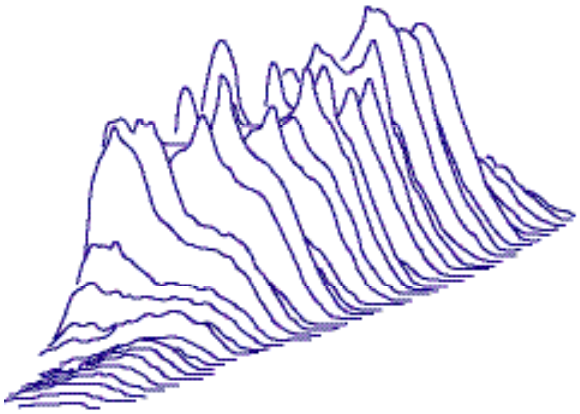
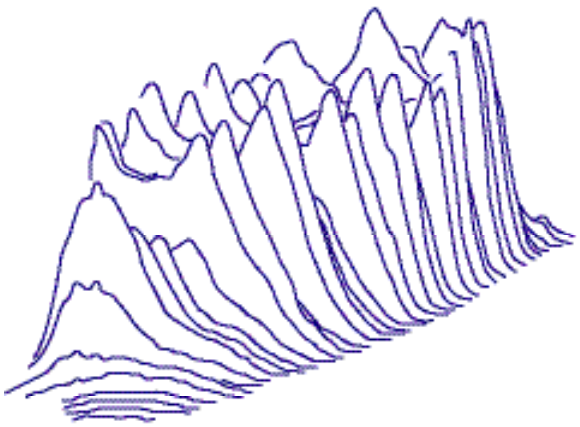
Beam H-	Measurement	Norm
Emittance (total)	3.551	0.142
Emittance (edge)	3.409 pi	
Emittance (rms)	0.441	0.018
Emittance (total/rms)	8.04	
Alpha	-1.499	
Beta	0.119	
4 x emittance (rms)	1.766 pi	
C	0.046 cm	
CP	-1.013 mr	
X Sigma	0.2295 cm	
XP Sigma	3.4670 mr	
Threshold	2.0%	
Threshold	29 CNTS	
Maximum counts	14	
Beam through threshold	3484	
Total beam	3665	
Charge-collector position	1364	1946
Jaw Position	1349	1938

beams.) The micropulse width for the PSR beam is 250 ns, whereas the micropulse width for the WNR beam is 20 ns. The rise and fall time of the pulse is about 7 ns. The capture efficiency of the PSR beam was 80% and that of the WNR beam was 50%. The beam loss in the machine for the WNR beam was about 30% of that of the PSR beam even though the average beam current for the WNR beam was only 4% of that of the PSR beam. Emittance of the WNR beam was reduced closer to that of the PSR beam by inserting beam-limiting jaws in the transport. The capture efficiency of this WNR beam then increased to 70%, and the beam loss went down to 10%. Theoretical calculations predict that fast chopping, narrow pulse width, and bunching affects beam emittance substantially.



Run: 14230/STN: TDEM1-H/12-17-02/21:09:18

Beam H-	Measurement	Norm
Emittance (total)	6.399	0.256 pi
Emittance (edge)	6.132 pi	
Emittance (rms)	0.900	0.036 pi
Emittance (total/rms)	7.11	
Alpha	-1.700	
Beta	0.208	
4 x Emittance (rms)	3.600 pi	
C	0.071 cm	
CP	-0.782 mr	
X Sigma	0.4327 cm	
XP Sigma	4.1037 mr	
Threshold	2.0%	
Threshold	18 CNTS	
Maximum counts	936	
Beam through threshold	364596	
Total beam	375201	
Charge-collector position	1340	1930
Jaw position	1340	1931



Run: 14231/STN: TDEM1-V/12-17-02/21:13:28

Beam H-	Measurement	Norm
Emittance (total)	6.010	0.240 pi
Emittance (edge)	5.788 pi	
Emittance (rms)	0.940	0.038 pi
Emittance (total/rms)	6.39	
Alpha	-1.409	
Beta	0.188	
4 x Emittance (rms)	3.761 pi	
C	0.022 cm	
CP	-1.248 mr	
X Sigma	0.4200 cm	
XP Sigma	3.8675 mr	
Threshold	2.0%	
Threshold	18 CNTS	
Maximum counts	928	
Beam through threshold	448075	
Total beam	454842	
Charge-collector position	1358	1943
Jaw position	1348	1938

Fig. 2. WNR beam emittance at the entrance to the LANSCE linac.

For more information, contact Chandra Pillai (LANSCE Division), (505) 667-8797, MS H812, pillai@lanl.gov.

Produced by the LANSCE-4 communications team: Sue Harper, Grace Hollen, Annie Loweree, Barbara Maes, and Sharon Mikkelson.